

CLAIMS

1. A method for detecting an endpoint , comprising:
illuminating a first portion of a surface of a wafer with first beam of broad band light;
receiving a first reflected spectrum data corresponding to a first plurality of spectra of
5 light reflected from the first illuminated portion of the surface of the wafer;
illuminating a second portion of the surface of the wafer with second beam of broad
band light;
receiving a second reflected spectrum data corresponding to a second plurality of
spectra of light reflected from the second illuminated portion of the surface of the wafer;
10 normalizing the first reflected spectrum data;
normalizing the second reflected spectrum data; and
determining an endpoint based on a difference between the normalized first spectrum
data and the normalized second spectrum data.
- 15 2. The method of claim 1, wherein the first spectrum data includes an intensity level
corresponding to each of a plurality of wavelengths in the corresponding first spectra.
3. The method of claim 2, wherein the plurality of wavelengths in the corresponding first
spectra includes a range of about 300 nm to about 720 nm.
- 20 4. The method of claim 3, wherein the plurality of wavelengths in the corresponding first
spectra includes a range of about 200 to about 520 individual data points.
5. The method of claim 1, wherein normalizing the first spectrum data includes
25 substantially removing the corresponding intensity values.
6. The method of claim 5, wherein, substantially removing the corresponding intensity
values includes modifying the intensity values of each one of the plurality of wavelengths such
that the sum the intensity values of each one of the plurality of wavelengths is equal to zero and
30 the sum of the square of the intensity values of each one of the plurality of wavelengths is equal
to one.

7. The method of claim 1, wherein determining the endpoint based on the difference between the normalized first spectrum data and the normalized second spectrum data includes determining a change in the proportions of intensity for at least a portion of the plurality of wavelengths in the first spectra and the second spectra.

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8. The method of claim 7, wherein, determining the change in the proportions of intensity for at least a portion of the plurality of wavelengths in the first spectra and the second spectra includes:

converting the normalized first spectrum data into a first vector;

10 converting the normalized second spectrum data into a second vector;

calculating a distance between the first vector and the second vector;

determining if the distance between the first and second vectors is greater than or equal to a threshold distance; and

15 identifying a change in the proportions of intensity for at least a portion of the plurality of wavelengths in the first spectra and the second spectra, if the distance between the first and second vectors is greater than or equal to the threshold distance.

9. A plasma etch system comprising:

20 a broad band light source for illuminating a portion of a surface of a wafer for a plurality of shots;

an optical detector for receiving reflected spectrum data corresponding to a plurality of spectrums of light reflected from the illuminated portion of the surface of the wafer for each of the plurality of shots;

logic for normalizing a first reflected spectrum data corresponding to a first shot;

25 logic for normalizing a second reflected spectrum data corresponding to a second shot; and

logic for determining an endpoint based on a difference between the normalized first spectrum data and the normalized second spectrum data.

30 10. The system of claim 9, wherein the logic for determining the endpoint based on the difference between the normalized first spectrum data and the normalized second spectrum data includes logic for determining a change in the proportions of intensity for at least a portion of the plurality of wavelengths in the first spectra and the second spectra.

11. The system of claim 10, wherein, determining the change in the proportions of intensity for at least a portion of the plurality of wavelengths in the first spectra and the second spectra includes:

5 logic for converting the normalized first spectrum data into a first vector;
 logic for converting the normalized second spectrum data into a second vector;
 logic for calculating a distance between the first vector and the second vector;
 logic for determining if the distance between the first and second vectors is greater than or equal to a threshold distance; and

10 logic for identifying a change in the proportions of intensity for at least a portion of the plurality of wavelengths in the first spectra and the second spectra, if the distance between the first and second vectors is greater than or equal to the threshold distance.

12. A system of detecting an endpoint comprising:

15 a broad band light source for illuminating a portion of a surface of a wafer for a plurality of shots;

 an optical detector for receiving reflected spectrum data corresponding to a plurality of spectrums of light reflected from the illuminated portion of the surface of the wafer for each of the plurality of shots;

20 logic for normalizing a first reflected spectrum data corresponding to a first shot;
 logic for normalizing a second reflected spectrum data corresponding to a second shot;
and

 logic for determining an endpoint based on a difference between the normalized first spectrum data and the normalized second spectrum data.

25 13. The system of claim 12, wherein the logic for determining the endpoint based on the difference between the normalized first spectrum data and the normalized second spectrum data includes logic for determining a change in the proportions of intensity for at least a portion of the plurality of wavelengths in the first spectra and the second spectra.

30 14. The system of claim 13, wherein, determining the change in the proportions of intensity for at least a portion of the plurality of wavelengths in the first spectra and the second spectra includes:

logic for converting the normalized first spectrum data into a first vector;
logic for converting the normalized second spectrum data into a second vector;
logic for calculating a distance between the first vector and the second vector;
logic for determining if the distance between the first and second vectors is greater than

5 or equal to a threshold distance; and

logic for identifying a change in the proportions of intensity for at least a portion of the plurality of wavelengths in the first spectra and the second spectra, if the distance between the first and second vectors is greater than or equal to the threshold distance.

10 15. The system of claim 12, wherein the first spectrum data includes an intensity level corresponding to each of a plurality of wavelengths in the corresponding first spectra.

16. The system of claim 15, wherein the plurality of wavelengths in the corresponding first spectra includes a range of about 300 nm to about 720 nm.

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17. The system of claim 16, wherein the plurality of wavelengths in the corresponding first spectra includes a range of about 200 to about 520 individual data points.

18. The system of claim 12, wherein the logic for normalizing the first spectrum data
20 includes logic for substantially removing the corresponding intensity values.

19. The system of claim 18, wherein, the logic for substantially removing the corresponding intensity values includes logic for modifying the intensity values of each one of the plurality of wavelengths such that the sum the intensity values of each one of the plurality of wavelengths
25 is equal to zero the sum of the squares of the intensity values of each one of the plurality of wavelengths is equal to one.

20. The system of claim 12, wherein the system of detecting an endpoint is incorporated in a proximity processing head.

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